

Effect of Educational Clinical Guidelines Program of Medication Errors on Pediatric Nurses' Knowledge Regarding Patient Safety

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Abstract:

Background: Medication errors are a major significant issue affecting patient safety in hospitals and often posing dangerous consequences for patients. In children medication errors cause appreciable morbidity and mortality.

Aim of the study: The aim of this study was to evaluate the effect of an educational clinical guidelines program of medication errors on pediatric nurses' knowledge regarding patient safety.

Research design: It is a quasi-experimental study. With one-group pre-test/post-test design.

Subject and methods: A convenient sample of (n=28) pediatric nurses recruited from different general wards (in patients) Pediatric University Hospital (EL Moniera Hospital) affiliated to Cairo University was constituted the sample of this study.

Tools of data collection: Tool I: part one for personal data of nurses, part two: Pre and post-test questionnaire of pediatric nurses' knowledge of medication administration and errors.

Tool II: Booklet of educational clinical guidelines program of reducing medication errors among pediatric nurses.

Result: There was a statistically significant improvement of pediatric nurses' knowledge level of medication errors regarding patient safety.

Conclusion & Recommendations: Implementation of clinical guidelines educational program of medication errors improves pediatric nurses' level of knowledge regarding patient safety. This study recommended that the assessment of medication errors should be done periodically by improving clinical guidelines of medication administration and educational training program about medication administrations and errors with patient safety should be applied.

Keywords: Clinical guidelines, Educational program, Medication errors, Patient safety

I. Introduction

Medication errors are common in hospitalized inpatients and are a high priority in healthcare systems worldwide (Roughead et al., 2013). Medication errors are one of the most common and preventable causes of iatrogenic injuries which contribute to the morbidity and mortality of hospitalized patients (Al-Jeraisy et al., 2011). Medication errors are common in pediatric patients; 5% to 27% of all pediatric medication orders result in a medication error for that, medication errors cause significant mortality and morbidity. Pediatric inpatients may have 3 times more medication errors in comparing with adult inpatients, and these errors are frequently harmful. For children, 1% of all medication errors carry a significant potential for harm, with 0.24% of errors causing actual harm, this may be because that children are at high risk for these errors due in part to the need for weight-based dosing (Rinke et al., 2014). When medication errors occur, pediatric patients have a much higher risk of death than adults. There are many factors that put children at a greater risk for medication errors, such as their variations in age and weight, high intra-patient variability, and rapid changes in the pharmacokinetic properties of drugs in children (Al-Jeraisy et al., 2011). John et al., (2012) add that children are particularly vulnerable to medication errors because drug dosages are calculated for body weight. Medication dosing errors occur in up to 17.8% of hospitalized children.

During calendar years 2006-2007, USP's MEDMARX® database shows nearly 2.5 percent of pediatric medication errors led to patient harm. The most common types of harmful pediatric medication errors were: improper dose/quantity 37.5%, followed by omission error (19.9%), unauthorized/wrong drug (13.7 %), and prescribing error (9.4 %), followed by wrong administration technique, wrong time, drug prepared incorrectly, wrong dosage form, and wrong route. Medication errors involving pediatric patients were most often caused by: performance deficit (43.0%), knowledge deficit (29.9%), procedure/protocol not followed (20.7%), and miscommunication (16.8%), followed by calculation error, inadequate or lack of monitoring, improper use of

pumps, and documentation errors (*The Joint Commission, 2008*). *Al-Jeraisy et al, (2011)* stated that although medication errors can be caused by all members of health care team, nursing medication errors are the most common. The reason is that nurses execute the majority of medical orders and spend about 40% of their time in the hospital to administer medicines. The rates of nursing medication errors are high in both developed and developing countries. To reduce this preventable harm, pediatric health systems, institutions, and providers must understand, implement, and augment interventions to reduce pediatric medication errors.

Medication administration is one of the most important duties of nurses. It requires a particular set of knowledge and attitude to be implemented correctly. Medication errors can put nursing practice at risk and can create preventable risk for children. Nurses hold responsibility for taking care of children and providing safety for them. Therefore, medication administration and preventing medication errors impose more obligations on them. Although there are abundant advantages and ethical bases in elaboration and reports of nurses' errors, it is very difficult to obtain accurate statistics of medication errors due to nurses' protection against punishment, absence of an appropriate reporting and recording system, and shortage of information (*Abusaad&Etawy, 2015*). The stages of the medication process include ordering/prescribing, transcribing/verifying, dispensing/delivering and administering; medication errors with pediatric patients have occurred at every stage of the process. Medication administration has been defined from the Nursing Interventions Classification (NIC) as preparing, giving and evaluating effectiveness of prescription and nonprescription medications (*Bulechek et al, 2008*). *College of Nurses of Ontario (2015)* outlines the expectations related to medication practices that promote public protection and describes nurses' accountabilities when engaging in medication practices, such as administration, dispensing, medication storage, inventory management and disposal, taking into consideration that nurses should ensure that they have the knowledge, skill and judgment needed to perform medication practices safely.

Children safety is a central concern of current health-care delivery systems. It is an important indicator of health care quality. Overall, in the third world and developing countries, it is difficult to acquire accurate estimates about medication administration errors due to absence of a proper recording and reporting system and shortage of research information, but experts speculate that the rate of these errors is high, and the increasing number of complaints against health care team in courts and to judicial authorities also confirms this (*Abusaad&Etawy, 2015*). Safe, competent and ethical medication management is more than performing the technical task of administering the medication. It requires nursing knowledge, skill and judgment. Safe and effective medication practices are a result of the efforts of many individuals and reliable systems. Safe medication management includes the knowledge of medication safety, human factors that may impact medication safety, limitations of medication systems and best practices to reduce medication errors (*College and Association of Registered Nurses of Alberta Provincial Council, 2015*).

A study of assessing nurses points of view for medication administration errors at children's university hospitals at Mansoura University children's hospital and El-Monaira children hospital at Cairo University Hospitals reported that Medication administration errors result from interrelated factors, concerning the types of errors occurred when the medication is delivered by the wrong route in 28.8%, changing of medication in 25% and frequency of medication in 23.80%, wrong drugs 22.5%, Wrong Dose in 21.3%, Wrong patient in 20%, Wrong time in 18.8, and no medication 16.3%, however, wrong date and wrong documentation were the least frequent in 15% and 13.80% respectively. The highest stages of medication errors was done by nurses as missing of medication, patients monitoring and medication administration (*Abusaad&Etawy, 2015*). In particular, reducing medication errors is an important part of ensuring patient safety in the pediatric population.

Significant of the study

A systematic review for describing medication errors in Middle Eastern countries, was conducted, this review reported that although the studies related to medication errors in the Middle Eastern countries were relatively few in number, Most of these studies were conducted on adult patients, while very few medication errors studies have been performed in pediatric hospitals. Many studies focused on prescribing errors and factors contributing to medication errors. The findings of the systematic review study highlighted that poor knowledge of medicines was a contributory factor in both prescribers and nurses administering drugs. For that, Middle Eastern countries urgently need to introduce educational programmes for improving knowledge of nurses to improve their quality of drug administration (*Alsulami et al., 2013*). A study was done in children's university hospital at Mansoura University, Abouelrash pediatric hospital and El-Monaira at Cairo University Hospitals was concluded that the highest types of medication errors as reported by studied nurses occurred when the medication is delivered by the wrong route, the highest stage of medication errors done by nurses was missing of medication then patient monitoring and administration and the highest cause of medication errors was due to heavy workload (*Abusaad&Etawy, 2015*). An educational program about medication administrations is essential to reduce medication errors and improve patient safety among pediatric nurses. This study is evaluated the effect of educational clinical guidelines program of medication errors on pediatric nurses' knowledge.

Aim of the study

The aim of this study was to evaluate the effect of an educational clinical guidelines program of medication errors on pediatric nurses' knowledge regarding patient safety.

Research hypothesis

Pediatric nurses who exposed to educational clinical guidelines program of medication errors will exhibit higher knowledge score in post-test than pre-test.

II. Subjects and Methods

Research design:

It is a quasi-experimental study. With one-group pre-test/post-test design.

Setting:

This study was conducted in general wards of Pediatric University Hospital (EL Moniera Hospital) affiliated to Cairo University, Egypt.

Sample:

Convenient sample of 38 staff nurses were included in the study. Sample size was calculated using EPI inf. (version 7.2) Program taken into consideration the total population (number of nurses working in the selected setting).

Tools of data collection:

Tool I: Knowledge questionnaire sheet: Pre and post-test questionnaire of pediatric nurses' knowledge of medication administration and errors.

The questionnaire was developed by the researchers which consist of two parts:

The first part was socio-demographic questionnaire; it elicits data about: Age, gender, unit/department, position, years of nursing experiences, qualification, if he/she has medication administration program before or not.

The second part was consisted of 20 items to identify nurses' knowledge about medication administration and errors. With four dimensions: international patient safety goals (2 items), clinical guidelines of medication administration (8 items), ten right of medication administration (4 items), and classification and management of Medication errors (6 items).

Tools validity: After the tool was developed by the researchers, validity was done by jury composed of five experts in academic nursing fields.

Tools reliability: the reliability test had done to the tool and was estimated using alpha scale as the following:

- International patient safety goals with Cronbach's Alpha ($\alpha = 0.716$)
- Clinical guidelines of medication administration with Cronbach's Alpha ($\alpha = 0.805$)
- The ten right of medication administration with Cronbach's Alpha ($\alpha = 0.699$)
- Classification and management of medication errors with Cronbach's Alpha ($\alpha = 0.639$)
- Total tool with Cronbach's Alpha ($\alpha = 0.905$)

Scoring system:

- Low level (less than 60%)
- Moderate (level from 60% to 85%)
- High level (more than 85%)

Tool II: Booklet of educational clinical guidelines program of reducing medication errors among pediatric nurses.

The booklet was developed by the researchers after reviewing the literature review and related researches (*The American Geriatrics Society, 2016; King Saud Bin Abdulaziz University for Health Sciences, 2008; World Health Organization, 2011; The Joint Commission, 2008; College of Nurses of Ontario, 2015; Australian Commission on Safety and Quality in Health Care, 2012*). It includes:

- ✓ Introduction
- ✓ International patient safety goals
- ✓ Overview of policy and procedure guideline of medication administration
- ✓ Rules of medication administration
- ✓ The ten right of medication administration
- ✓ Calculation of pediatric medication dose
- ✓ High alert medication
- ✓ Medication sensitivity
- ✓ Classification of medication errors
- ✓ Common factors of medication errors
- ✓ Strategies of managing medication errors

- ✓ Sample of incident report of medication errors (developed by researchers)
- ✓ Sample of Flow chart of medication administration clinical guidelines (developed by researchers)

Content validity:

It was done by five experts in academic nursing fields and two expertises from the nursing administrative staff from the hospital of the study.

III. Methods of data collection

Written approval

An official permission was obtained from the researchers to the director of the hospital for approval of conducting the program.

Ethical consideration

Before conducting the program, informed oral consent was obtained from the nurses after explanation of the aim individually.

Pilot study

It was conducted on 8 staff nurses in a selected setting for testing clarity and applicability of the study tool of pre- posttest questionnaires. The purpose of the pilot study was to detect any particular problem in the statements clarity, and reliability of the tool. The data obtained from the pilot study were analyzed; little change was done in questionnaire, so the pilot study was excluded from the main study sample.

Data collection procedure

Data were collected during the period from June 2016 to October 2016.

1. Preparation phase

Development of the program:

- The program was developed by the researchers after reviewing of the literature. This program was developed based on assessment needs after reviewing current national and international studies, and their recommendation (*Alsulami et al., 2013; Abusaad&Etawy, 2015*).
- In additional, the researchers were assessed medication errors in the hospital of the study by interviewing some staff nurses and nurse managers individually and explain the aim and purpose of the study.

2. Implementation phase

- **Before implementation of educational program:** The data was collected by the researchers and the questionnaire sheets were distributed to studied sample (pretest) before starting each program session.
- **During implementation of educational program:** The program was implemented four times for four groups of pediatric staff nurses during the morning shift, one session every week, in seminar room in the hospital. Each session allocated time 60 minutes, and the total allocated time for achieving the whole program to all study sample was four hours (4 sessions × 60 min), in addition to half hour for pre and post testquestionnaire sheets . Collaborative lectures with data show presentation, group discussion, and brain storming were used as learning methods during each session.
- **After implementation of educational program:** Post testquestionnaire sheets were distributed to studied samplepost immediately and. The time needed to complete each sheet ranged from 10-15minutes

3. Evaluation phase

After implementation of the educational clinical guidelines program of medication errors regarding patient safety, pediatric nurses' knowledge was evaluated through filling immediate post questionnaire sheets and the booklets were distributed. Follow up has been done for nurses' knowledge in study for a period of one month later by one post questionnaire sheets. Evaluation of the educational clinical guidelines program was done on three phases (before the program, immediate after the program, and one month after the program).

Statistical Analysis

The collected data were analyzed and results were tabulated by using statistical package for social science (SPSS) version 20. Frequency and percentage were used for numerical data as well as mean and standard deviation. For quantitative data Pearson correlation coefficient were used to describe association between variables. Probability (*p*-value) less than 0.05 was considered significant.

IV. Result

Table (1) showed that 52.7% of the study subjects have age from 35 to less than 45 years old with mean score (36.605±5.863), and the majority (94.7%) is females. Regarding to the qualification, 81.6% of the study subjects have nursing school diploma, and the majority (92.1%) is staff nurses. In relation to the years of experience, 34.3% of the study subjects have from 10 to less than 15 years with mean score (15.526±4.780). In additional, 50% of the study subjects are working in medical unit and the reimaging 50% working in surgical unit. About half of the study subjects (57.9%) didn't have a Medication administration program before. Table (2) indicated the levels of nurses' knowledge about the dimensions of medication administration and error during

different phases of program intervention. The majority level of nurses' knowledge of the first dimension about International Patient Safety Goals before program was moderate (65.8%), then immediate after program it was increased to moderate and high (both 50%), and at last one month after program, it was high (55.3%). The majority level of nurses' knowledge of the second dimension about Clinical Guidelines of Medication Administration before program was moderate (73.7%), then immediate after program it was increased to high (60%), and at last one month after program, it was high (63.2%). The majority level of nurses' knowledge of the third dimension about Ten Right of Medication Administration before program was low (84.2%), then immediate after program it was increased to high (89.5%), and at last one month after program, it was high (92.1%). The majority level of nurses' knowledge of the fourth dimension about Classification & Management of Medication Errors before program was low (100%), then immediate after program and one month after program it was increased to moderate (39.5%,44.7%) and high (28.9%, 31.6%).

Table (3) illustrated the Levels of the total nurses' knowledge about medication administration and Error during different phases of program intervention. Before the program, the total level of nurses' knowledge was low (100%) with minimum and maximum score of (3-12). Immediate after program, the majority total level of nurses' knowledge was moderate (89.5%), and minority was (10.5%) with minimum and maximum score of (13-19). One month after program, the majority total level of nurses' knowledge was moderate (86.8%), and minority was (13.2%) with minimum and maximum score of (13-19).Table (4) presented the mean score and correlation of the nurses' knowledge about dimensions of medication administration and Error during different phases of program intervention. The mean score (0.815±0.562) of the first dimension about International Patient Safety Goals before program was improved immediate after program (1.500±0.506) and one month after program (1.552±0.503). The mean score (4.000±0.900) of the second dimension about Clinical Guidelines of Medication Administration before program was improved immediate after program (6.394±1.001) and one month after program (6.578±0.758). The mean score (1.736±0.794) of the third dimension about Ten Right of Medication Administration before program was improved immediate after program (3.894±0.311) and one month after program (3.921±0.273). The mean score (1.184±0.691) of the fourth dimension about Classification & Management of Medication Errors before program was improved immediate after program (3.973±0.787) and one month after program (4.105±0.798).The table showed highly statistically significant improvement of nurses' knowledge in all dimensions of medication administration and Error during different phases of program intervention.

Table (5) showed the mean score and correlation of the nurses' knowledge about total medication administration and Error during different phases of program intervention. The mean score before program (7.736±1.826) was improved immediate after program (15.763±1.496) and one month after program (16.157±1.241). There was highly statistically significant improvement of nurses' knowledge of medication administration and Error during different phases of program intervention (p=0.000).Table (6) illustrated the Correlation between nurses' knowledge about total medication administration and Error and their demographic characteristics during different phases of program intervention. There was a statistically significant between position of the nurse and their knowledge during different phases of program intervention. On the other hand, there was no significant between the other demographic characteristics of nurses and their knowledge about total medication administration and Error.

Table (1): Demographic characteristics of the study subjects (n=38)

Demographic characteristics	No	%
Age:		
<30	4	10.5
30- <35	9	23.7
35 - <45	20	52.7
≥ 45	5	13.1
Mean ±SD	36.605±5.863	
Gender		
Male	2	5.3
Female	36	94.7
Qualification		
Nursing school diploma	31	81.6
Technical nursing institute	4	10.5
Bachelor of nursing	3	7.9
Position		
Staff Nurse	35	92.1
Head Nurse	1	2.6
Supervisor	2	5.3
Years of nursing experience		
<10	5	13.1
10-<15	13	34.3
15-<20	10	26.3

□ 20	10	26.3
Mean ±SD	15.526±4.780	
Unit		
Medical	19	50
Surgical	19	50
Have a Medication administration program before		
Yes	16	42.1
No	22	57.9

Table (2): Levels of nurses' knowledge about the dimensions of medication administration and error during different phases of program intervention (n=38)

Dimensions		Before program		Immediate after program		One month after program	
International Patient Safety Goals	Low	No	%	No	%	No	%
	Moderate	10	26.3	0	0	0	0
High	25	65.8	19	50	17	44.7	
Clinical Guidelines of Medication Administration	Low	3	7.9	19	50	21	55.3
	Moderate	10	26.3	0	0	0	0
	High	28	73.7	15	39.5	14	36.8
Ten Right of Medication Administration	Low	0	0	23	60	24	63.2
	Moderate	32	84.2	0	0	0	0
	High	6	15.8	4	10.5	3	7.9
Classification & Management of Medication Errors	Low	0	0	34	89.5	35	92.1
	Moderate	38	100	12	31.6	9	23.7
	High	0	0	15	39.5	17	44.7

Low level (less than 60%) Moderate (level from 60% to 85%) High level (more than 85%)

Table (3): Levels of the total nurses' knowledge about medication administration and Error during different phases of program intervention (n=38)

Total	Before program		Immediate after program		One month after program	
	No	%	No	%	No	%
Low	38	100	0	0	0	0
Moderate	0	0	34	89.5	33	86.8
High	0	0	4	10.5	5	13.2
Minimum	3		13		13	
Maximum	12		19		19	

Low level (less than 60%) Moderate (level from 60% to 85%) High level (more than 85%)

Table (4): Mean score and correlation of the nurses' knowledge about dimensions of medication administration and Error during different phases of program intervention (n=38)

Dimensions of questionnaire	Before program	Immediate after program	One month after program	Correlation	
	Mean ± SD	Mean ± SD	Mean ± SD	r	p
International Patient Safety Goals	0.815±0.562	1.500±0.506	1.552±0.503	0.900	0.000*
Clinical Guidelines of Medication Administration	4.000±0.900	6.394±1.001	6.578±0.758	0.902	0.002*
Ten Right of Medication Administration	1.736±0.794	3.894±0.311	3.921±0.273	0.854	0.003*
Classification & Management of Medication Errors	1.184±0.691	3.973±0.787	4.105±0.798	0.907	0.000*

*Significant (P<0.05)

Table (5): Mean score and correlation of the nurses' knowledge about total medication administration and Error during different phases of program intervention (n=38)

Item	Before program	Immediate after program	One month after program	Correlation	
	Mean ± SD	Mean ± SD	Mean ± SD	r	p
Total Knowledge	7.736±1.826	15.763±1.496	16.157±1.241	0.906	0.000*

*Significant (P<0.05)

Table (6): Correlation between nurses' knowledge about total medication administration and Error and their demographic characteristics during different phases of program intervention (n=38)

Total	Before program		Immediate after program		One month after program	
	r	p	r	p	r	p
Age	0.118	0.480	0.271	0.100	0.260	0.115
Gender	0.034	0.837	0.038	0.822	0.030	0.856
Qualification	0.262	0.112	0.251	0.128	0.233	0.160
Position	0.477	0.002*	0.425	0.008*	0.422	0.008*
Years of Experiences	0.100	0.551	0.267	0.105	0.277	0.092
Unit	0.058	0.728	0.160	0.336	0.172	0.302
Have Previous program	0.095	0.571	0.028	0.865	0.108	0.520

*Significant ($P < 0.05$)

V. Discussion

Preventing further mistakes in future and patients' safety are the famous benefits about the medication errors. Shortage of nursing staff, errors of timing drugs, the condition of the patient, the type of hospital and ward, fear from reporting consequence, threat of management, fear from evaluation score and the lack of knowledge about unit policies are the important factors which are affected the medication errors and refusing to report. Concerning about medications administered during care and monitoring patients can be affecting the treatment. Nurses because of their position to notice medication errors at first can thereby take steps to reduce the risk of incorrect medication errors (*Geravandi et al., 2016*).

By virtue of their direct patient-care activities and administration of medications to patients, nurses perhaps more than any other health care providers in an excellent position to detect and report medication errors. Nurses often serve as the final point in the checks-and-balances triad between physicians and pharmacists, thus they play an important role in risk reduction. The study results indicate that about more than half of the study subjects hadn't attended a medication administration training program before. In accordance with other studies, *Toruner (2012)* conducts a study to determine the perspective of pediatric nurses regarding the causes, reporting, and prevention of medication errors. The researcher reported that nurses most commonly cited lack of appropriate guidelines for drug administration to pediatric patients, insufficient knowledge of the medication, and inaccurate or poor reading of prescriptions as the primary causes of medication errors. Nurses' highlighted the need for additional information and/or guidelines regarding drug administration. Regular briefing of pediatric nurses on safe medication administration and proper training of newly engaged nurses have been suggested as routes to reduce medication errors. In the same context *Cheragi et al. (2013)* explained and evaluated the possible different types and causes of medication errors from the viewpoint of the nurses selected and found that the most important cause of medication errors was a lack of pharmacological knowledge. *Dent (2015)* added that numerous studies have indicated medication errors to be the result of lack of in-service training and inadequate knowledge of nursing graduates. *Alagha et al. (2011)* stated that in many countries, there are system checks in hospitals that allow for the monitoring of prescriptions and as much as 70% of prescribing errors may be intercepted by pharmacists and nurses. The situation in most of the hospitals in Egypt is totally different as pharmacist and nurses are not involved actively in the medication-use process. They do not attend physician rounds, revise medication orders, recheck dose calculations nor provide any drug information or educational services.

Concerning to the level of nurses' knowledge about the dimensions of medication administration and error during different phases of program intervention, majority of nurses had low level of knowledge regarding to international patient safety goals, clinical guidelines of medication administration, ten right of medication administration and classification & management of medication errors then their knowledge level increase to moderate and high immediate after program one month later. The findings showed highly statistically significant improvement of nurses' knowledge in all dimensions of medication administration and Error during different phases of program intervention. This findings agree with many researchers recommended increasing pharmacological knowledge of nurses as a strategy to reduce serious medication errors, as in a study done by *Elmour et al. (2008)* they designed and implemented an educational program to raise the awareness of in-patient nursing staff about medication errors and other medication-related safety issues in Al Ain hospital. The Findings revealed differences in the knowledge of nurses about the causes and reporting of medication errors. The participant's responses improved significantly and there were change in mean scores pre and post intervention. In the same context, *Alsulami et al (2013)* reported that based on their review results, the main factor contributing to medication errors in Middle Eastern countries is poor knowledge of medicines in both doctors (prescribers) and nurses (administering drugs), as was also the case with other studies. Educational

programmers for drug prescribers and nurses concerning drug therapy are urgently needed to avoid drug errors and to improve patient safety. In a recent systematic review by *Rinke et al (2014)* regarding interventions to reduce pediatric medication errors, they found multiple interventions revealed statistically significant effects. Twenty studies reported provider education as part of their intervention to reduce pediatric medication errors; fourteen studies used education as their main intervention to reduce pediatric medication errors; and all of them emphasized on the effectiveness of educational systems and its impact on reducing medication error

In a recent study done in Egypt by *Abusaad and Etawy (2015)* who examine types, stages, causes of medication errors, barriers of medication administration errors reporting and its facilitator at pediatric University hospitals from nurses point of view, insufficient training program and lack of dosage guidelines for pediatric population are the third cause as reported by more than one quarter of studied nurses. *Gorgich et al. (2016)* stated that false medicinal calculations, insufficient pharmacological knowledge and illegibility of patients' records are the most common medication errors among nurse students. They assess nurses' view point on how to prevent medication errors the results showed that reducing the work pressure by increasing the number of staff proportional to the number and status of patients, staff training and information about new drugs were the most important ways to prevent medication errors. From the compiled results regarding the correlation between nurses' knowledge about total medication administration and error and their demographic characteristics during different phases of program intervention, there was a statistically significant between position of the nurse and their knowledge during different phases of program intervention. On the other hand, there was no significant between the other demographic characteristics of nurses as years of experiences, qualification and their knowledge about total medication administration and Error. This finding was somewhat unexpected; however, on the contrary *Elnour et al. (2008)* found that there were statistically significant differences in responses across the participant's years of experience and the current clinical working area and their improvement of knowledge of nurses about the causes and reporting of medication errors. *Feleke (2015)* stated that nurse's working experience, interruption of the nurses at the time of medication administration, shift of medication administration, and nurse to patient ratio were found to be significantly associated with medication administration error. A substantial number of studies have identified that age of the respondent and working experience was significantly associated with medication administration error (*Fahimi, 2008; Westbrook, 2011*). This study also supported the above claim. This can be explained by the fact that medication administration is one of the nurse's practices that improves with age and experience. In addition, nurses with more years and work experience have greater knowledge and skills related to medication administration. They are also very familiar with different types of medications. Moreover, *Biftu (2016)* states that nurses who had educational status of bachelor science of nursing and above were more than one times more likely reported medication administration errors (MAE) than those participants who had educational status of diploma. This is due to the fact that those participants who had higher educational status may have higher knowledge, attitude and practice toward the drug adverse effect or they may develop confidence to defend the consequence of medication administration errors (MAE) through their educational journey.

VI. Conclusion

Implementation of clinical guidelines educational program of medication errors improves pediatric nurses' level of knowledge regarding patient safety. In addition, the booklet which distributed after program as a handout was supported the nurses' knowledge.

Recommendations

This study recommended that:

- Educational training program about medication administrations and errors with patient safety should be applied periodically.
- The assessment of medication errors should be done periodically for improving clinical guidelines of medication administration and patient safety.
- Designing an appropriate safe work environment for nurses conducive for patient care delivery for reduce the occurrence of medication error.
- A proper functioning standardized system should be developing for medication errors detection and reporting.
- Improve medication error reporting systems and policy among nurses by removing barriers, clarifying the importance of reporting and encouraging them to report medication errors with supporting from nursing administration.
- Coordination between all healthcare team members especially physicians, pharmacists and nurses also, provide clinical pharmacists in the hospitals and improve their role to reduce medication error.

- Future studies of medication errors related to patient safety in pediatric and other health care setting should focus on nurse workloads and knowledge for developing appropriate guidelines to increase nursing professional career development.

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